

Claims

- [c1] What is claimed is:
- An apparatus for measuring downhole pressures, the apparatus disposed in a downhole drilling tool positionable in a wellbore having an annular pressure therein, the wellbore penetrating a subterranean formation having a pore pressure therein, the apparatus comprising:
- at least one pressure equalizing mechanism capable of equalizing an internal pressure of the apparatus with one of the annular pressure and the pore pressure; and
- a pressure gauge for measuring the internal pressure.
- [c2] The apparatus of claim 1, wherein the at least one pressure equalizing mechanism comprises:
- a first fluid passage positionable in fluid communication with the formation, the pressure gauge operatively connected to the first fluid passage;
- a second fluid passage in fluid communication with the wellbore; and
- a valve assembly capable of selectively connecting the first and second whereby pressure is equalized therebetween.
- [c3] The apparatus of claim 2 further comprising a filter connected to the first passage for preventing the flow of solids into the first passage.
- [c4] The apparatus of claim 3 wherein the filter is a porous solid selected from the group of metal and ceramic.
- [c5] The apparatus of claim 3 wherein the filter is positioned in a protrusion extending from the drilling tool, the filter defining a contact surface disposable adjacent the wall of the wellbore.
- [c6] The apparatus of claim 5, wherein the protrusion forms at least a portion of a bottom hole assembly connected to the downhole drilling tool.
- [c7] The apparatus of claim 5 wherein the protrusion is selected from the group of a wear band, a stabilizer, and an under reamer.
- [c8] The apparatus of claim 2, wherein the second passage comprises a pressure

chamber, the pressure chamber having a movable piston therein defining a variable volume fluid chamber and a variable volume buffer chamber, the fluid chamber in fluid communication with the wellbore, the buffer chamber having a buffer fluid therein equalized to pressure in the fluid chamber, the buffer chamber in selective communication with the first passage via the valve assembly.

[c9] The apparatus of claim 8 wherein the buffer fluid is selected from the group of hydraulic fluid, nitrogen gas and water.

[c10] The apparatus of claim 8 wherein the valve assembly comprises a sliding valve movable between an open and closed position.

[c11] The apparatus of claim 10 wherein when the sliding valve is in the closed position and the first passage is in fluid communication with the formation, the fluid in the first passage equalizes to the pore pressure whereby the pressure gauge reads pore pressure.

[c12] The apparatus of claim 10 wherein when the sliding valve is in the open position, the fluid in the first passage equalizes to the fluid in the second passage whereby the pressure gauge reads annular pressure.

[c13] The apparatus of claim 10 wherein the valve assembly further comprises an actuator capable of selectively moving the sliding valve between the open and closed position.

[c14] The apparatus of claim 10 wherein the valve assembly further comprises a check valve for selectively permitting fluid to flow through the sliding valve in the open position.

[c15] The apparatus of claim 10 wherein the valve assembly further comprises a spring capable of applying force to maintain the sliding valve in one of the open and closed position.

[c16] An apparatus for measuring downhole pressures, the apparatus disposed in a downhole drilling tool positionable in a wellbore having an annular pressure therein, the wellbore penetrating a subterranean formation having a pore

pressure therein, the apparatus comprising:

a first fluid passage positionable in fluid communication with the formation;
a second fluid passage in fluid communication with the wellbore;
a control valve capable of selectively connecting the first and second passage
whereby, an internal pressure in the first fluid passage is equalized to one of
the annular pressure and the pore pressure; and
a pressure gauge connected to the first fluid passage for measuring the internal
pressure.

- [c17] The apparatus of claim 16 further comprising a filter connected to the first passage for preventing the flow of solids into the first passage.
- [c18] The apparatus of claim 17 wherein the filter is a porous solid selected from the group of metal and ceramic.
- [c19] The apparatus of claim 17 wherein the filter is positioned in a protrusion extending from the drilling tool, the filter defining a contact surface disposable adjacent the wall of the wellbore.
- [c20] The apparatus of claim 19, wherein the protrusion forms at least a portion of a bottom hole assembly connected to the downhole drilling tool.
- [c21] The apparatus of claim 19 wherein the protrusion is selected from the group of a wear band, a stabilizer, and an under reamer.
- [c22] The apparatus of claim 1, wherein the second passage comprises a pressure chamber, the pressure chamber having a movable piston therein defining a variable volume fluid chamber and a variable volume buffer chamber, the fluid chamber in fluid communication with the wellbore, the buffer chamber having a buffer fluid therein equalized to pressure in the fluid chamber, the buffer chamber in selective communication with the first passage via the control valve.
- [c23] The apparatus of claim 22 wherein the buffer fluid is selected from the group of hydraulic fluid, nitrogen gas and water.
- [c24] The apparatus of claim 23 wherein the control valve comprises a sliding valve movable between an open and closed position.

- [c25] The apparatus of claim 24 wherein when the sliding valve is in the closed position and the first passage is in fluid communication with the formation, the fluid in the first passage equalizes to the pore pressure whereby the pressure gauge reads pore pressure.
- [c26] The apparatus of claim 24 wherein when the sliding valve is in the open position, the fluid in the first passage equalizes to the fluid in the second passage whereby the pressure gauge reads annular pressure.
- [c27] The apparatus of claim 24 wherein the control valve further comprises an actuator capable of selectively moving the sliding valve between the open and closed position.
- [c28] The apparatus of claim 24 wherein the control valve further comprises a check valve for selectively permitting fluid to flow through the sliding valve in the open position.
- [c29] The apparatus of claim 24 wherein the control valve further comprises a spring capable of applying force to maintain the sliding valve in one of the open and closed position.
- [c30] A downhole drilling tool capable of measuring downhole pressures during a drilling operation, the downhole drilling tool positionable in a wellbore having an annular pressure therein, the wellbore penetrating a subterranean formation having a pore pressure therein, comprising:
a bit;
a drill string;
at least one drill collar connected to the drill string;
at least one pressure mechanism disposed in the drill collar, the pressure mechanism capable of equalizing an internal pressure of the drill collar with one of the annular pressure and the pore pressure; and
a pressure gauge for measuring the internal pressure.
- [c31] The apparatus of claim 30, wherein said pressure mechanism comprises:
a first fluid passage positionable in fluid communication with the formation, the pressure gauge operatively connected to the first fluid passage;

a second fluid passage in fluid communication with the wellbore; and
a valve assembly capable of selectively connecting the first and second passage
whereby pressure is equalized therebetween.

- [c32] The apparatus of claim 30 further comprising a filter connected to the first passage for preventing the flow of solids into the first passage.
- [c33] The apparatus of claim 32 wherein the filter is a porous solid selected from the group of metal and ceramic.
- [c34] The apparatus of claim 32 wherein the filter is positioned in a protrusion extending from the drill collar, the filter defining a contact surface disposable adjacent the wall of the wellbore.
- [c35] The apparatus of claim 34 wherein the protrusion is selected from the group of a wear band, a stabilizer, and an under reamer.
- [c36] The apparatus of claim 31, wherein the drill collar forms at least a portion of a bottom hole assembly connected to the downhole drilling tool.
- [c37] The apparatus of claim 30, wherein the second passage comprises a pressure chamber, the pressure chamber having a movable piston therein defining a variable volume fluid chamber and a variable volume buffer chamber, the fluid chamber in fluid communication with the wellbore, the buffer chamber having a buffer fluid therein equalized to pressure in the fluid chamber, the buffer chamber in selective communication with the first passage via the valve assembly.
- [c38] The apparatus of claim 37 wherein the buffer fluid is selected from the group of hydraulic fluid, nitrogen gas and water.
- [c39] The apparatus of claim 37 wherein the valve assembly comprises a sliding valve movable between an open and closed position.
- [c40] The apparatus of claim 39 wherein when the sliding valve is in the closed position and the first passage is in fluid communication with the formation, the fluid in the first passage equalizes to the pore pressure whereby the pressure

gauge reads pore pressure.

- [c41] The apparatus of claim 39 wherein when the sliding valve is in the open position, the fluid in the first passage equalizes to the fluid in the second passage whereby the pressure gauge reads annular pressure.
- [c42] The apparatus of claim 39 wherein the valve assembly further comprises an actuator capable of selectively moving the sliding valve between the open and closed position.
- [c43] The apparatus of claim 39 wherein the valve assembly further comprises a check valve for selectively permitting fluid to flow through the sliding valve in the open position.
- [c44] The apparatus of claim 39 wherein the valve assembly further comprises a spring capable of applying force to maintain the sliding valve in one of the open and closed position.
- [c45] A method of measuring downhole pressures during a drilling operation in a wellbore having an annular pressure therein, the wellbore penetrating a formation having a pore pressure therein, the method comprising:
positioning a downhole drilling tool in a wellbore, the downhole drilling tool having a pressure equalizing mechanism therein;
equalizing an internal pressure of the downhole drilling tool with one of the annular pressure of the wellbore and the pore pressure of the subterranean formation; and
measuring the internal pressure.
- [c46] The method of claim 45 further comprising the step of establishing fluid communication between a fluid chamber of the pressure equalizing mechanism and the wellbore.
- [c47] The method of claim 46 further comprising the step of equalizing pressure between a hydraulic chamber of the pressure equalizing mechanism and the fluid chamber.
- [c48] The method of claim 47 further comprising the step of selectively connecting

the hydraulic chamber to a measurement chamber via a valve assembly movable between an open and closed position.

- [c49] The method of claim 48 further comprising the step of filtering fluids entering an opening of the measurement passage.
- [c50] The method of claim 48 wherein the step of selectively connecting comprises moving the valve assembly to the closed position when the drilling tool is at rest and to the open position at all other times.
- [c51] The method of claim 50 further comprising the step of equalizing pressure between the hydraulic chamber and the measurement passage when the valve assembly is in the open position.
- [c52] The method of claim 51 wherein the step of measuring the internal pressure comprises measuring the pressure in the measurement passage whereby the annular pressure is determined.
- [c53] The method of claim 50 further comprising the step of positioning an opening of the measurement passage adjacent the wellbore wall.
- [c54] The method of claim 53 wherein the step of positioning comprises positioning an opening of the measurement passage adjacent the wellbore wall by scraping mud away from the wellbore wall so that a contact surface of the pressure equalizing mechanism is disposed adjacent the wellbore wall.
- [c55] The method of claim 53 further comprising the step of establishing fluid communication between the measurement passage and the formation.
- [c56] The method of claim 55 further comprising the step of equalizing pressure between the measurement passage and the formation when the valve is in the closed position.
- [c57] The method of claim 56 wherein the step of measuring the internal pressure comprises measuring the pressure in the measurement passage whereby the pore pressure is determined.
- [c58] The method of claim 49 further comprising the step of equalizing pressure

between the formation hydraulic chamber and the measurement passage when the valve assembly is in the closed position.

- [c59] A method of equalizing an internal pressure of a downhole drilling tool disposed in a borehole with one of an annular pressure of the borehole and the pore pressure of a surrounding formation, said method comprising:
allowing drilling fluid in the borehole to enter an opening in the bottom hole assembly and flow into a wellbore cavity;
equalizing pressure between the wellbore cavity and a measurement cavity via a cylinder, the cylinder having a piston therein defining a fluid chamber and a buffer chamber, the wellbore cavity in fluid communication with a wellbore chamber, the buffer chamber in selective fluid communication with the measurement cavity; and
taking a pressure reading of the measurement cavity.
- [c60] The method of claim 59 further comprising filtering wellbore fluids from entering the measurement cavity.
- [c61] The method of claim 59 further comprising interrupting fluid communication between the buffer chamber and the measurement cavity when the downhole tool is at rest.
- [c62] The method of claim 61 positioning the measurement cavity in fluid communication with the formation.
- [c63] The method of claim 62 equalizing the pressure between the formation and the measurement cavity.
- [c64] The method of claim 62 wherein the step of equalizing comprises allowing fluid from the measurement cavity to flow between the measurement cavity and the formation until fluid pressure equalizes.
- [c65] The method of claim 63 measuring pressure of fluid in the measurement cavity whereby the pore pressure is determined.